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**GB 1046862**

**EP 0159583**

**GB 1325808**

EP A 0228241

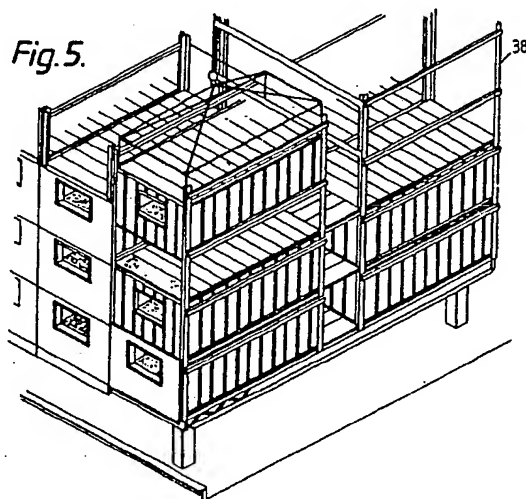
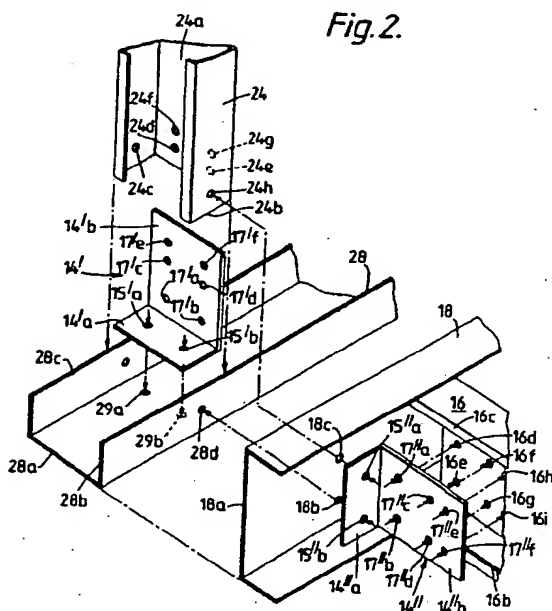
WO 86/01848

**(58) Field of search**

**E1D**

### Selected US specifications from IPC sub-class E04C

(57) The joint comprising at least three elongate steel channel-section members (16,18,24,28) secured to angle brackets so that they extend from or cross a common origin. The structure can be used at each corner of the framework of an accommodation unit (see Fig. 5).



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*Fig.1.*

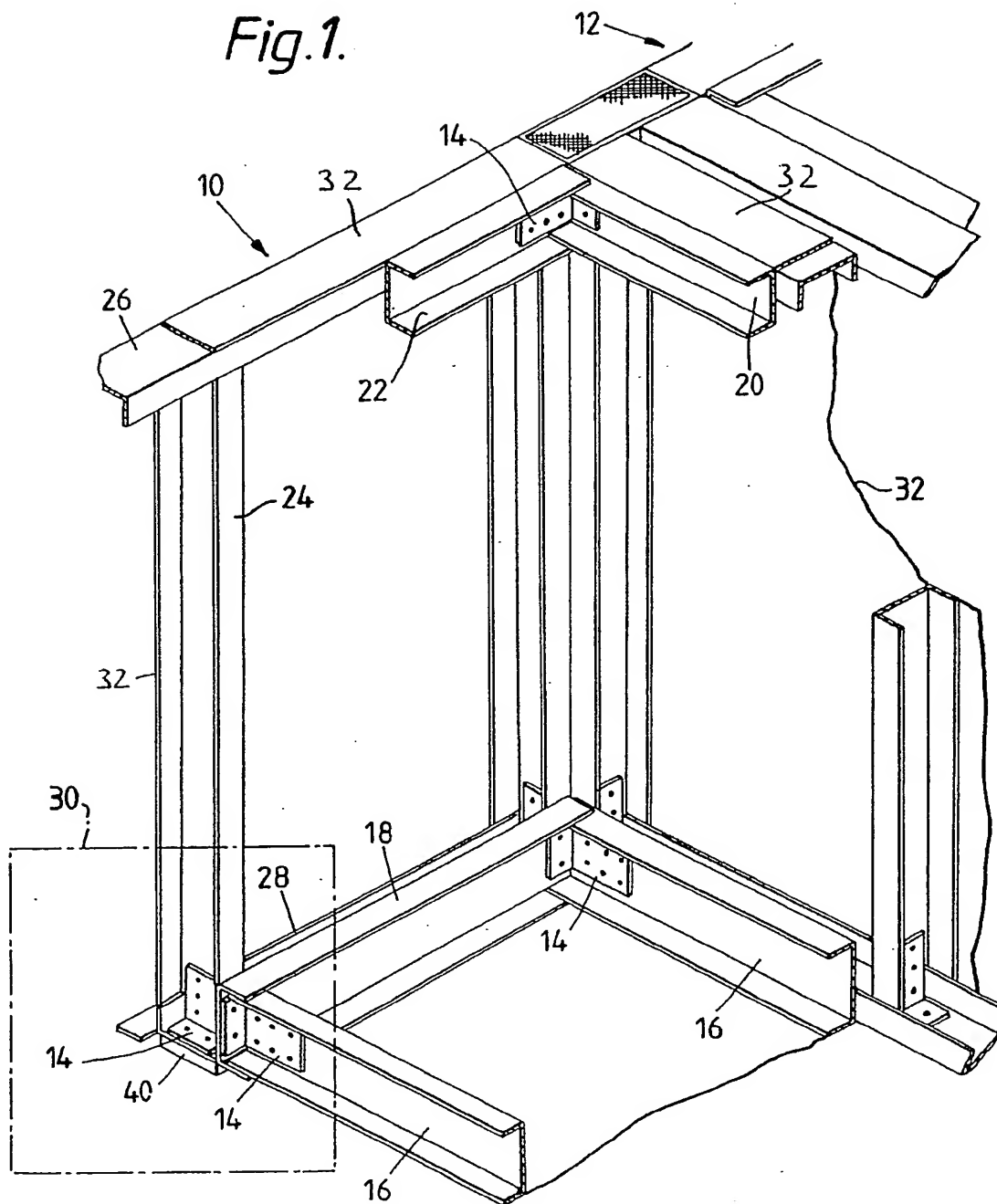
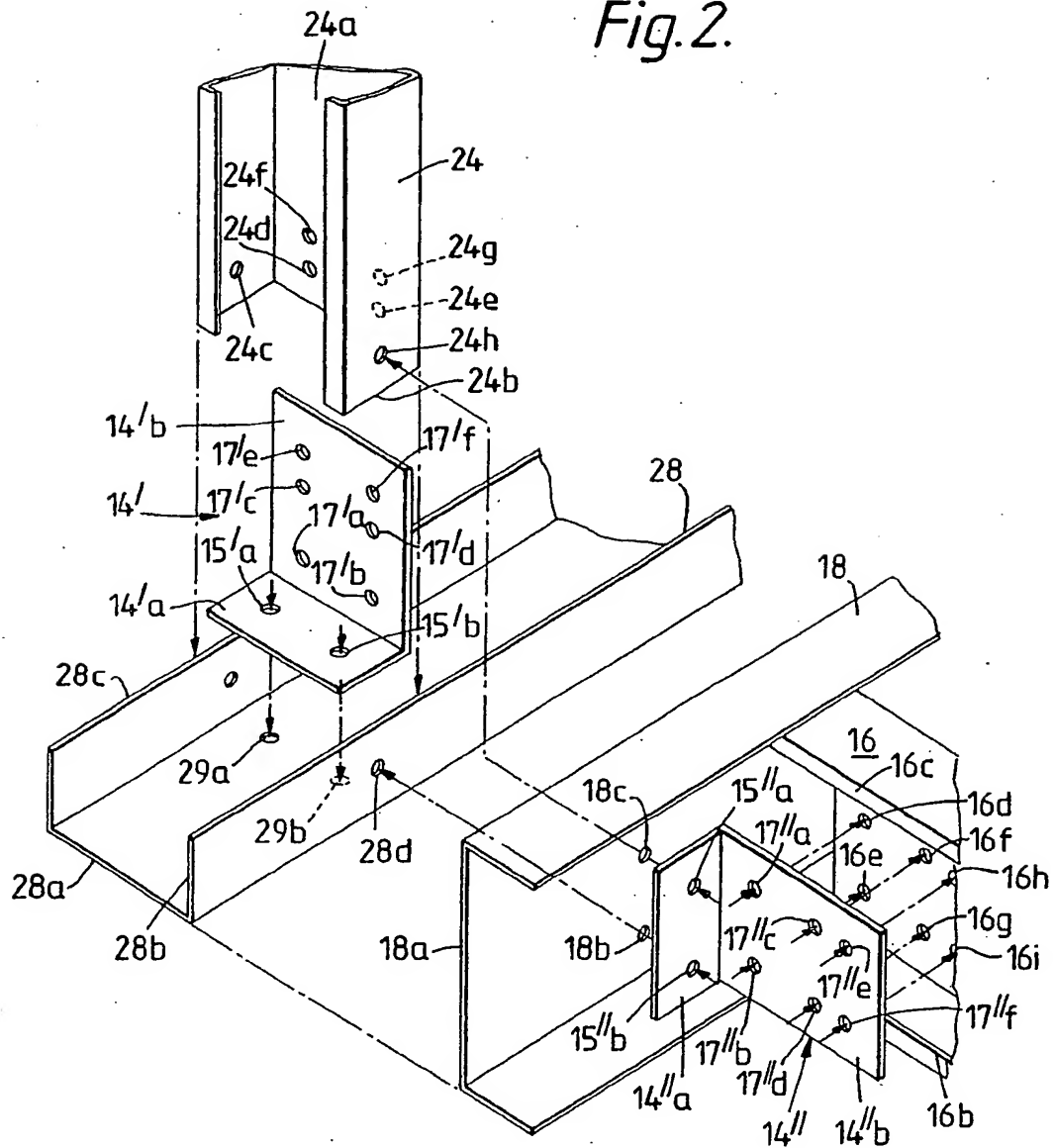
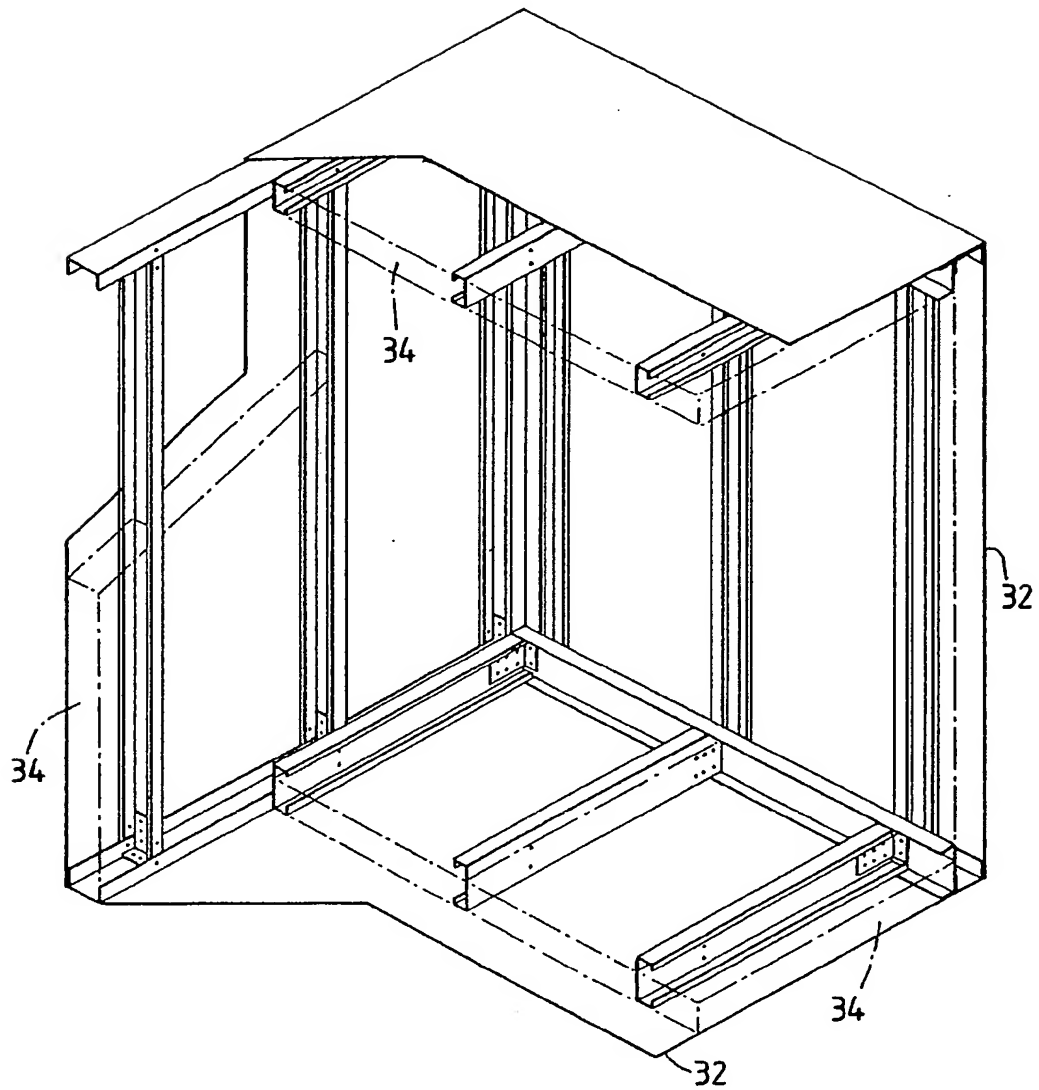


Fig. 2.



*Fig. 3.*

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Fig. 4.

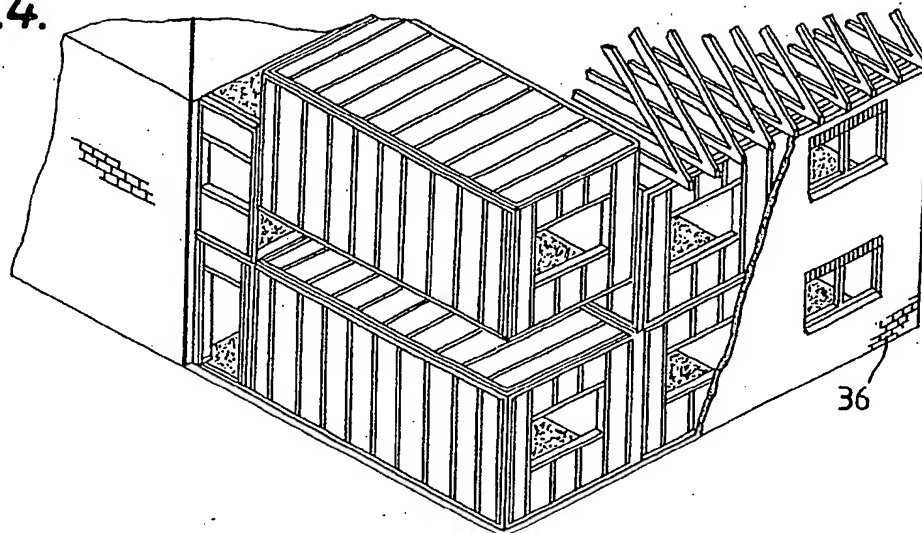
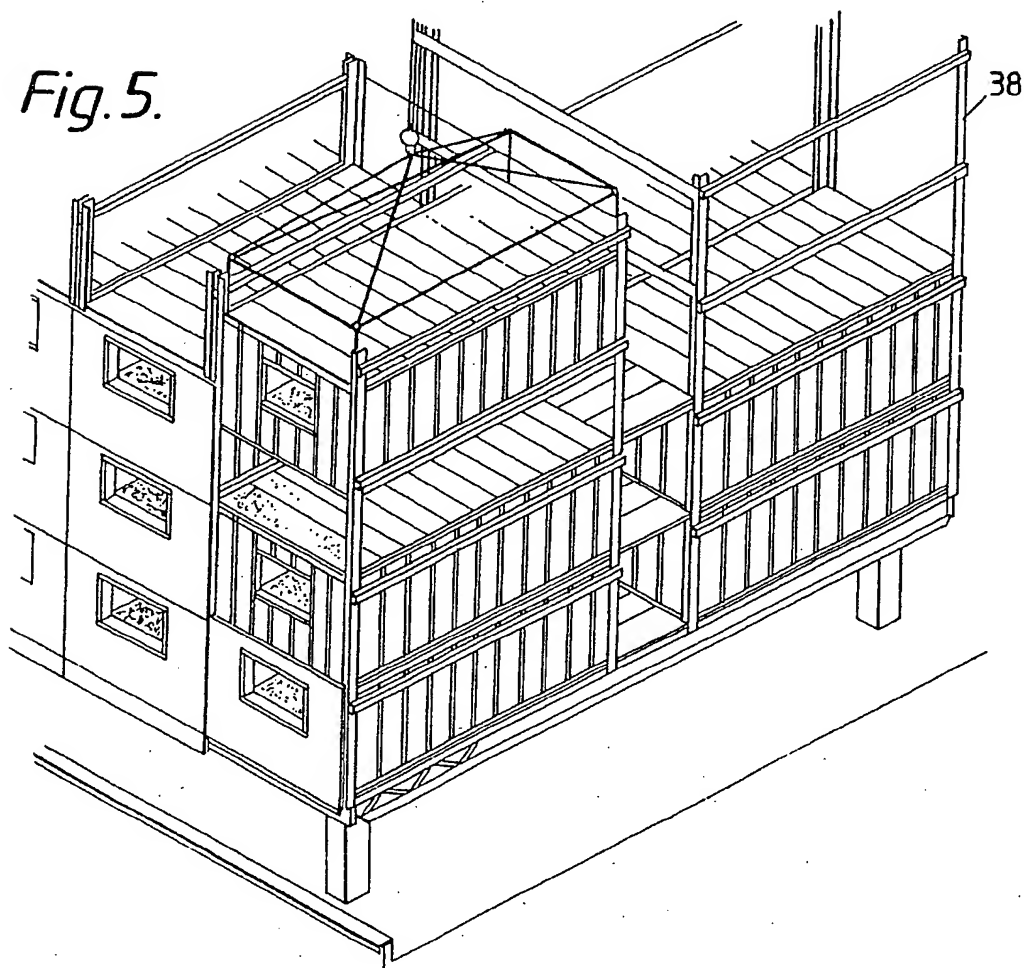


Fig. 5.



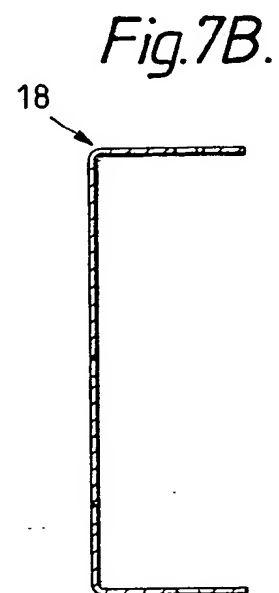
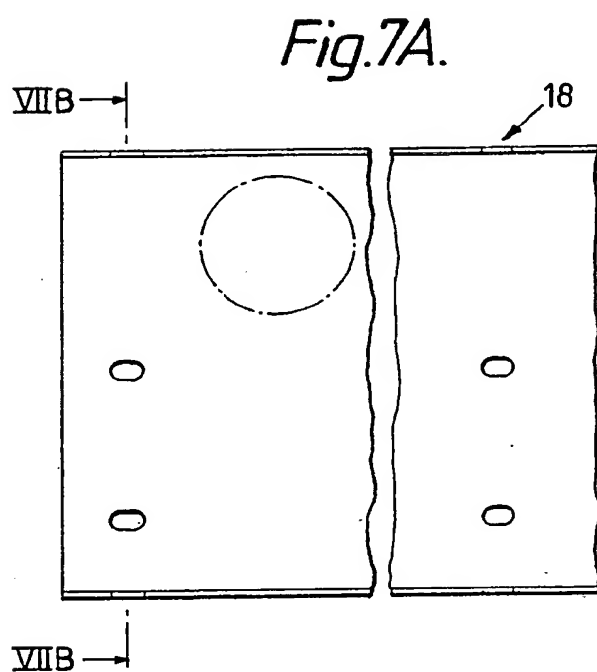
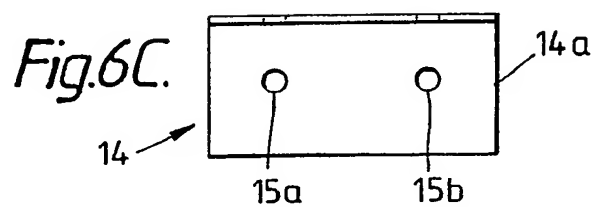
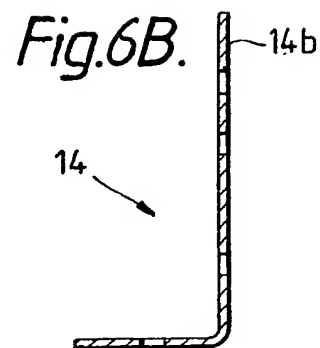
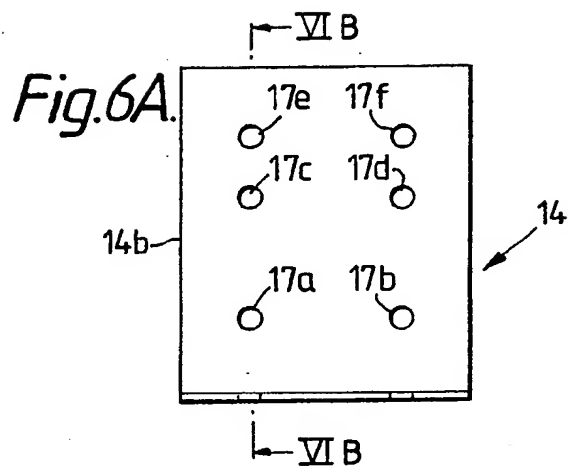


Fig. 8A.

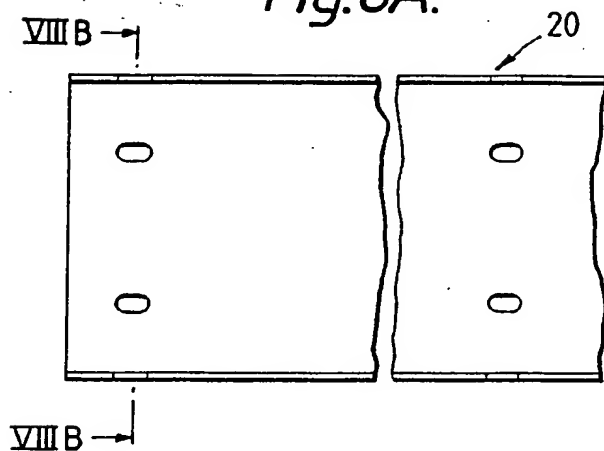


Fig. 8B.

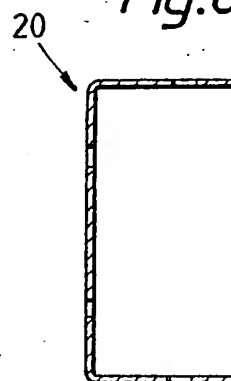


Fig. 9A.

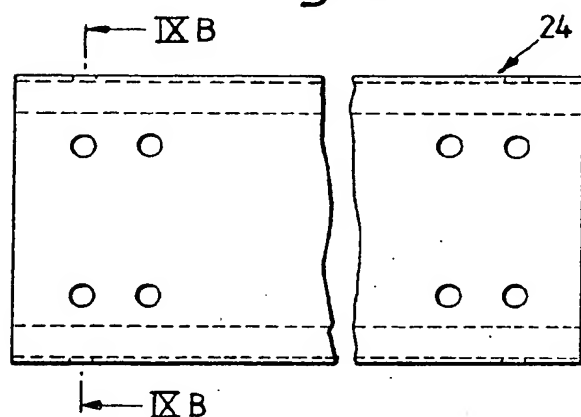


Fig. 9B.

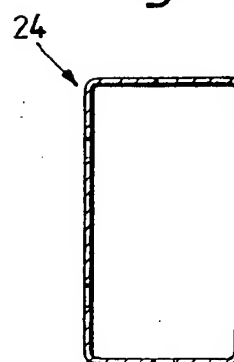
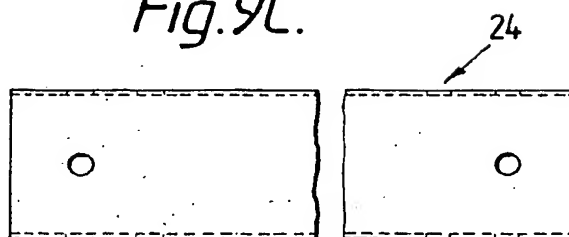
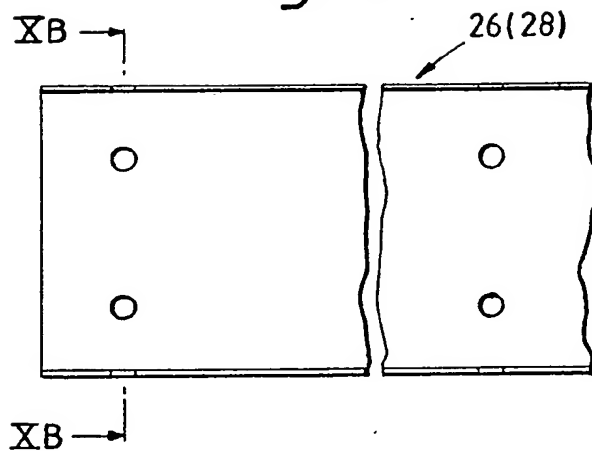
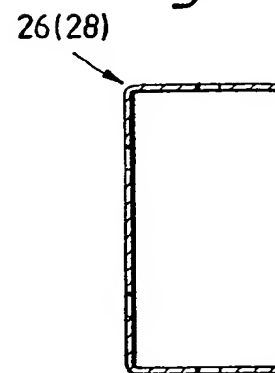
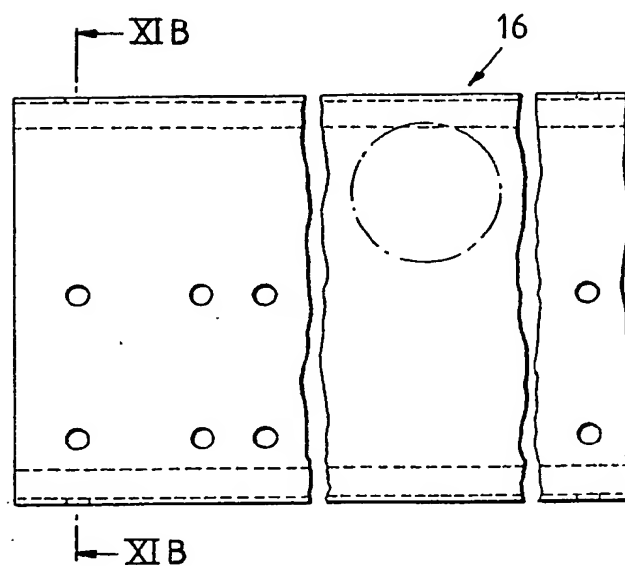
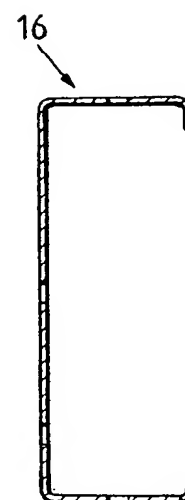


Fig. 9C.



*Fig.10A.**Fig.10B.**Fig.11A.**Fig.11B.*



## SPECIFICATION

**Improvements in methods of assembling structures**

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This invention relates to a method of assembling a structure, such as a building structure, to a kit of parts for use in such a method and to structure made thereby or therefrom.

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One application of the invention is in the manufacture of transportable accommodation units for use as or in building constructions.

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Factory-built transportable accommodation units are known and have wide application including domestic use as living accommodation such as a "mobile home" or commercial use such as office or factory space. Furthermore, such units can be used alone or linked together in some way to provide the required accommodation space.

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Such known accommodation units are manufactured by erecting a wooden framework defining the overall shape, door frames, window frames and the like. The wooden framework is then covered with a weatherproof material such as aluminium sheet and lined with a suitable material such as hardboard or plastics sheet or plasterboard with an insulating material sandwiched therebetween.

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Although wood has been used for the manufacture of such frameworks for many years, it is not entirely satisfactory. Among the problems encountered with the use of wood are:

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a) Movement between members of the framework and warping and twisting of individual members due to changes in the water content of the wood, due both to the wood drying out as it seasons and water penetration,

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b) Variations in the quality of the material from one piece to another

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c) Not easily machined to close tolerances,

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d) Because wood has to breathe it is difficult to seal and to provide adequate insulation in a convenient way for example between airways and ventilated cavities under floors,

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e) Liable to deterioration due to water penetration, fungal attack and insect infestation.

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In addition, it has not been found convenient to make such units of any desired dimension but rather to provide them in given module sizes which the customer/user has to accept.

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Alternative materials to wood have therefore been sought but metals, such as steel, have not been adopted because of the difficulty in finding a simple, inexpensive and efficient means of connecting together the individual structural framework members.

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Steel framed buildings in which the steel framework for the building is permanently erected on site and the walls, floors, ceilings and roof built around the framework are, of course, known. However, to date, the

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methods and means of connecting together

the individual frame members have not been easily adapted for use in the manufacture of transportable building units.

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According to one aspect of the invention there is provided a method of assembling a structure, such as a building structure, comprising arranging a plurality of building members to extend from or to cross a common origin and fixedly securing a bracket to the members in the vicinity of the origin thereby to maintain the members in fixed orientations to each other.

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Three building members can be so arranged in mutually orthogonal axes.

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One or more of the building members can be of channel section having a base portion and opposed wall portions. The bracket may be a substantially right-angled bracket having a width dimensioned to be received on the base portion between the wall portions of the channel section or sections. The length of one limb of the bracket may be dimensioned to be substantially equal to or less than the dimension of a wall portion from the base portion to the distal end thereof.

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According to another aspect of the invention there is provided a kit of parts for carrying out the method according to the first aspect of the invention.

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According to a third aspect of the invention, there is provided a structure assembled by the method according to the invention.

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The invention will now be described by way of example with reference to the accompanying drawings, in which:

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Fig. 1 shows a perspective view partly cut away of parts of two adjoining accommodation units made according to the invention,

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Fig. 2 is an exploded view showing the manner in which a plurality of building members can be fixedly secured together by a bracket according to the invention,

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Fig. 3 is a perspective view partly cut-away of another accommodation unit,

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Fig. 4 is a view partly cut away showing one method of assembling together a plurality of accommodation units to form a building construction,

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Fig. 5 is a view showing another method of assembling together a plurality of accommodation units to form a building construction,

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Figs. 6 to 11 illustrate embodiments of bracket and various channel members for use in the invention.

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In the drawings, like parts are given like references.

Referring to Fig. 1, there is shown part of the frameworks 10, 12 of two accommodation units made according to the invention.

Each framework comprises a plurality of building members in the form of galvanised steel channel sections fixedly secured together by substantially right-angled galvanised steel brackets 14.

The brackets, in this embodiment are all of

the same dimensions but the channel members can have different cross-sectional dimensions and lengths depending upon their particular function and the dimensions of the accommodation unit.

For example in Fig. 1 there are shown floor joists 16, floor joist terminator channels 18, ceiling joists 20, ceiling joist terminator channels 22, vertical channels 24, top channels 26 and base channels 28 as shown. Clearly, the external cross-sectional width of channel 16 is made such that it will fit into channel 18; likewise channel 20 fits into channel 22.

The brackets 14, have a width such that they will locate on the internal base surface of any channel member with which it is to be used. Each bracket 14 has a short limb 14a which has a length equal to or less than the height of a wall of the channel members and is provided with apertures 15a, b, for receiving fixing members such as rivets, bolts or the like. The other limb 14b of each bracket can be of any convenient length consistent with ease of handling and the need for providing apertures therein, in this case six apertures 17a to f.

Fig. 2 shows, in an exploded view, how two brackets can be used to secure together several channel members and can be likened to the assembly shown within the broken line 30 of Fig. 1 and it will be understood that the channel members will have been provided with apertures corresponding to the apertures 15, 17 in the brackets 14.

The channel members can be secured to the brackets 14 by any suitable means such as nuts and bolts and rivets. For use with rivets, hydraulic or pneumatic rivetors are preferred to ensure that each rivet is fixed to a consistent predetermined amount to ensure good quality control.

In Fig. 2, bracket 14' has its limb 14'a secured to the base 28a of channel 28 by means of rivets (not shown) which pass through apertures 15'a and 15'b and corresponding apertures 29a and 29b in channel 28. Vertical channel 24 is positioned normal to the length of channel 28 with its edges 24b, c terminating just above walls 28b and 28c of channel 28. Channel 24 is then fixedly secured to bracket 14' by means of rivets which pass through apertures 17a to d and corresponding apertures 24d to g formed in base 24a of channel 24.

Bracket 14'' has its short limb 14''a fixedly secured to wall 28b of channel 28 and base 18a of channel 18 by way of a rivet which passes through respective apertures 15''b, 18b and 28d. Limb 14''a is also secured to wall 24b of channel 24 and base 18a of channel 18 by way of a rivet which passes through respective apertures 15''a, 18c and 24b. The long limb 14''b is secured to the base 16a of channel 16 by rivets which pass through respective apertures 17''a to f and

16d to i.

Thus, bracket 14'' fixedly secures together channels 16, 18, 24 and 28 which extend in three orthogonal axes in such a way that they extend from or cross a common origin to provide a simple, inexpensive and convenient fixing with the required strength.

The other channels in the framework are fixed together in a similar manner.

Doors, windows, service and other openings can be provided easily and conveniently using the same fixing methods to provide the necessary sub frameworks.

Because of the easy fixing method and the use of metal channel members which can be made and cut to close tolerances, it is possible to manufacture accommodation units to any dimension in height, length and width up to maximum dimension consistent with transportability.

Prior to leaving the factory, the framework is provided with an external waterproof plastics skin 32 to protect it both in transport and *in situ*. The plastics skin 32 can conveniently be secured to the external surfaces of the framework channels by double-sided adhesive tape.

Insulation 34 (Fig. 3), such as plastics foam insulation is then applied to fill the space between the channel members and plastics sheet to provide fully insulated wall floor and ceiling areas. Suitable plastics foam insulating material can be obtained which will adhere both to metal and plastics membrane 32. A suitable material is polyisocyanurate.

The accommodation unit can be supplied as a shell, or with closures for the windows, doors and other openings or *completely* fitted out at the factory according to the customer's requirements. For example, floor boards can be fitted and plasterboard fitted to the walls and ceilings. Units can be further fitted out to include decorations, furniture, sanitary, plumbing, electrical and other services so that on site only external connections need to be made by the local contractor.

Accommodation units can be supplied singly or in any number to be assembled together for use as required, for example to providing residential or commercial accommodation, a hospital, school or hotel.

Figs. 6 to 11 show embodiments of a bracket 14 and channel members 16, 18, 20, 24, 26 and 28 not to the same scale.

Fig. 4 shows one method of assembling the accommodation units together in which the units are self supporting as a low-rise assembly of, say, up to three storeys. Means (not shown) can be provided to interlock and fasten the units together. As aforementioned, each unit is fully waterproofed at the factory but an outer skin, such as outer brickwork 36 can be provided for extra protection and to give the required aesthetic appearance.

Fig. 5 shows another method of assembling

the units together in which the units are assembled within a prefabricated major steel frame 38. The units can be conveniently lowered into position by means of a crane and resilient means, such as rubber compression pads 40 (Fig. 1) are provided between adjacent channel members of adjoining units to insulate one from the other. The thickness of the pad 40 is made just greater than the maximum distortion of the channels it separates to ensure that vibration and the resultant unpleasant sound and other effects is not transmitted from one unit to another.

Thus accommodation units made according to the invention have at least the following benefits over wood-framed units:

a) The material is of consistent quality so that the assembly can be designed to meet predetermined criteria which result in little or substantially no twisting or relative movement of individual frame members;

b) Metal is easily machined to close tolerances facilitating flexibility in design and dimensions;

c) Because there is no organic material in the framework the unit can be factory sealed to prevent the ingress of moisture. Separate damp-proof membranes are not required;

d) Insulation can be bonded to the structure to reduce heat loss and the transmission of sound, with continuity of the insulation around the walls, ceiling and floor;

e) The self-supporting structure obviates the need for sleeper walls.

### CLAIMS

1. A method of assembling a structure, such as a building structure, comprising arranging at least three metal building members to extend from or to cross a common origin and fixedly securing a bracket to the members in the vicinity of the origin thereby to maintain the members in fixed orientations to each other.

2. A method according to claim 1, in which there are three building members arranged in mutually orthogonal axes.

3. A method according to claim 1 or 2, in which at least one of the building members is of channel section having a base portion and opposed wall portions.

4. A method according to claim 3, in which the bracket is a substantially right-angled bracket having a width dimensioned to be received on the base portion between the wall portions of the channel section or sections.

5. A method according to claim 3 or 4, in which the length of one limb of the bracket is dimensioned to be substantially equal to or less than the dimension of a wall portion of a channel member from the base portion to the distal end thereof.

6. A method of assembling a structure substantially as hereinbefore described with reference to the accompanying drawings.

7. A kit of parts for carrying out the method according to any one of claims 1 to 6.

8. A structure assembled by the method according to any one of claims 1 to 7.

9. A building construction comprising at least one structure according to claim 8.

10. A structure comprising at least three elongate metal building members fixedly secured to a bracket and so arranged that they extend from or cross a common origin.

11. A structure according to claim 10, in which there are three building members arranged in mutually orthogonal directions.

12. A structure according to claim 10 or 11, in which at least one of the building members is of channel section having a base portion and opposed wall portions.

13. A structure according to claim 12, in which the bracket is a substantially right-angled bracket having a width dimensioned to be received on the base portion between the wall portions of a channel-section building member.

14. A structure according to claim 13, in which the length of one limb of the bracket is dimensioned to be substantially equal to or less than the dimension of a wall portion of a channel member from the base portion to the distal end thereof.

15. A structure according to any one of claims 10 to 14, in which the building members are fixedly secured to the bracket by rivets, nuts and bolts or the like.

16. A structure according to any one of claims 10 to 15, in which the building members are appropriate members selected from floor joists, floor joist terminator members, ceiling joists, ceiling joist terminator members, verticle members and the like of an accommodation unit.

17. A structure according to any one of claims 14 to 16, in which the building members are of steel.

18. A structure substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

19. An accommodation unit comprising a structure according to any one of claims 10 to 18.

20. An accommodation unit according to claim 19, comprising one of said structures at a or at each corner of said unit to form a framework for the unit.

21. An accommodation unit according to claim 20, in which the framework is provided with sub frameworks to define openings such as doorways, windows and service openings.

22. An accommodation unit according to claim 20 or 21, in which the framework is provided with a protective outer cover or skin.

23. An accommodation unit according to claim 22, in which the cover or skin is a plastics sheet secured to the external surfaces of the framework.

24. An accommodation unit substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

25. A building construction comprising a plurality of accommodation units according to any one of claims 19 to 23.

26. A building construction substantially as hereinbefore described with reference to the accompanying drawings.

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